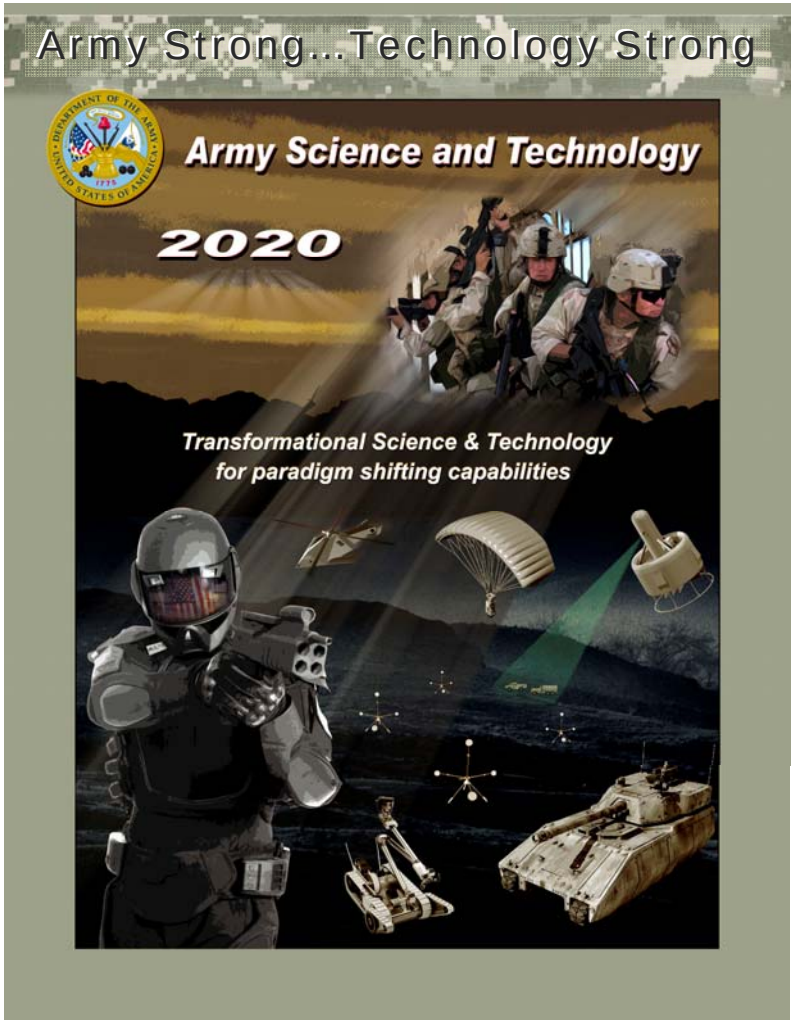
Technology for Future Warfighting

Army Science Conference

27 Nov 2006



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Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

Science & Technology for a Campaign Quality Army with Joint & Expeditionary Capabilities

Current Force

~100 lb. load

70+ tons

< 10 mph

Strategy

Enabling the Future Force

Science and Technology—develop and mature technology to enable transformational capabilities for the Future Modular Force while seeking opportunities to accelerate technology directly into the Current Modular Force

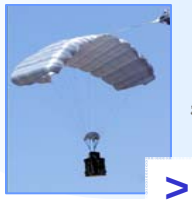
Enhancing the Current Force

Future Force

< 40 lb. load

Fully networked

< 30 tons

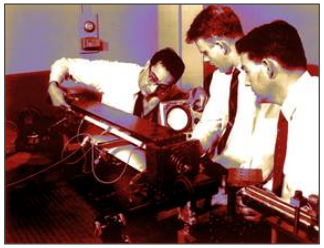


> 40 mph

Generations of Game Changing Technologies

Decade of the 1950's

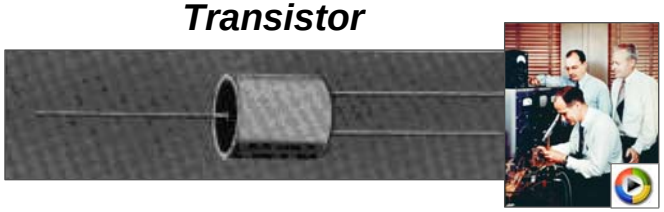
Lasers

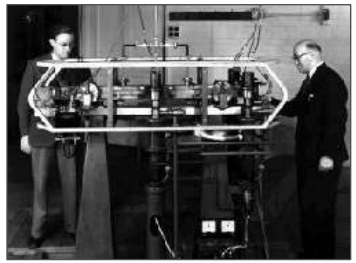


Programmable Systems

WWII Ballistic Computing/ ENIAC

Transistor



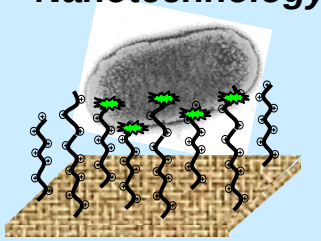


Atomic Clock

DNA

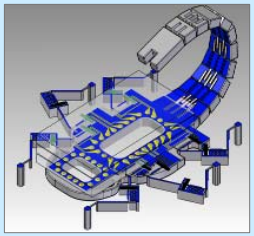
Today for 2020 and beyond…

Nanotechnology



Institute for Soldier Nanotechnologies (ISN)

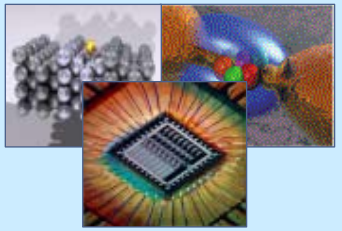
Micro-robotics



Immersive Environments

Institute for Creative Technologies (ICT)

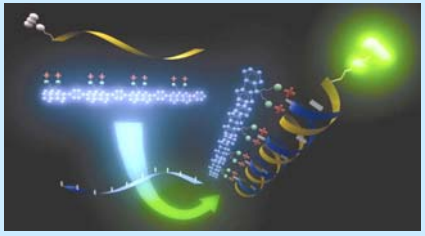
High Performance Computing



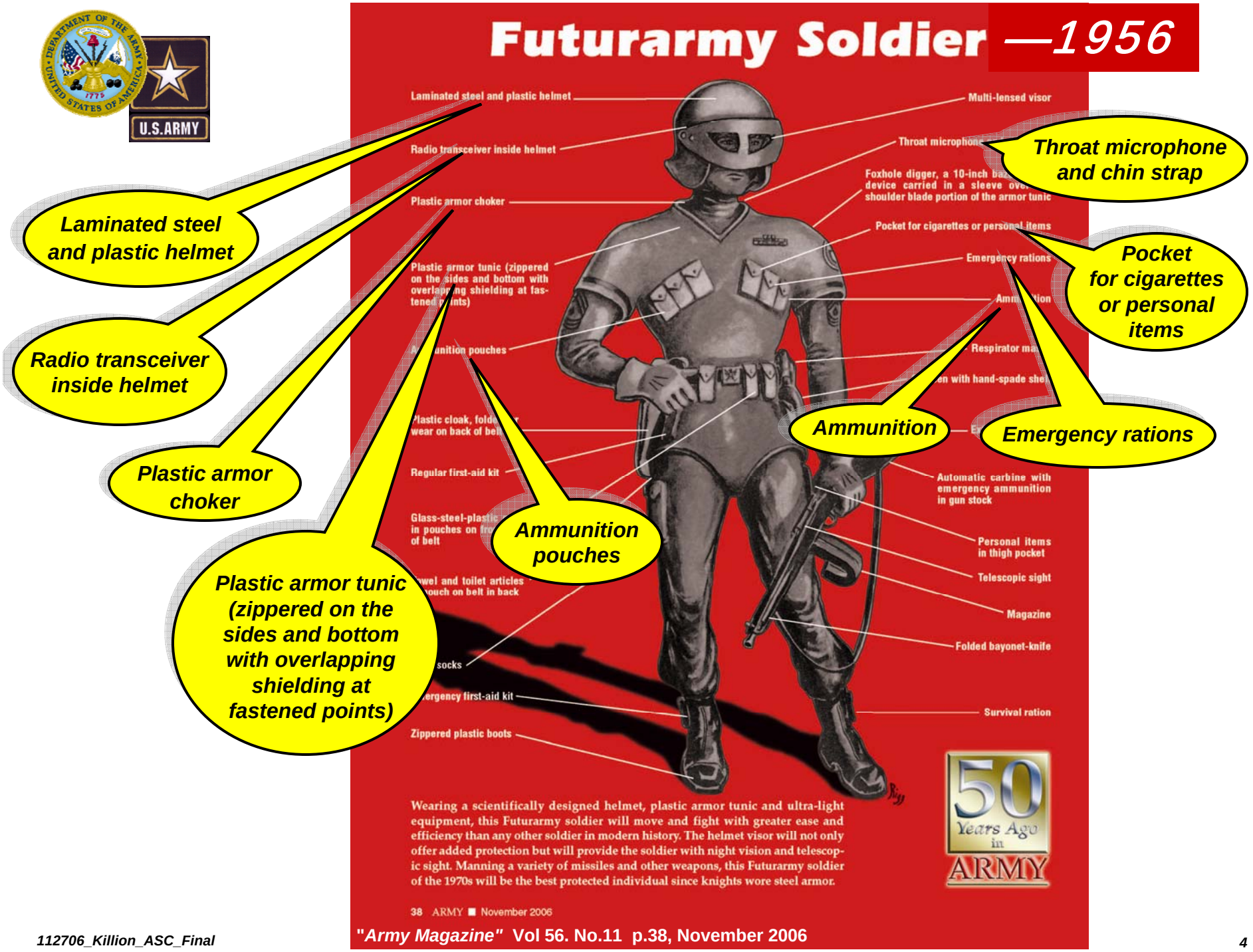
The Network

Flexible Displays

Biotechnology



Institute for Collaborative Biotechnologies (ICB)

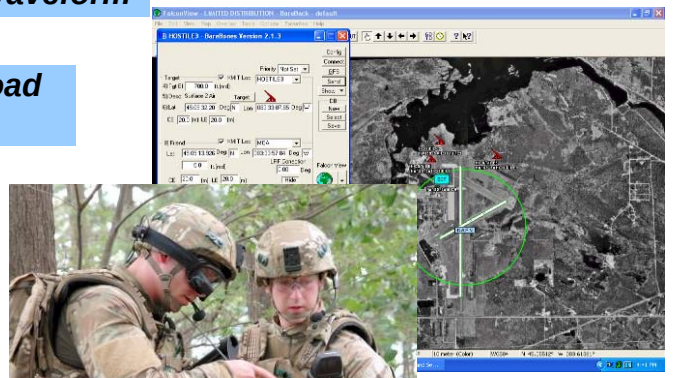


"*Army Magazine*" Vol 56. No.11 p.38, November 2006

Future Force Warrior (FFW)—2006

- *FFW Increment 1 at C4ISR OTM Jun-Aug 06:*
  - *Integration into Future Force network via Soldier Radio Waveform*
  - *Current force integration via FBCB2*
  - *Integrated combat ensemble with stand-off body armor/load carriage/electronics and signature management*
  - *Squad level NLOS cooperative engagement*
  - *Headgear with integrated fused thermal and I2*
  - *System voice control*
- *FFW Early Increment 2 improvements at OTM 06 and AAEF/Spiral C:*
  - *Beyond squad level NLOS cooperative engagement*
  - *Digital target hand-off to joint platforms (F-16, A-10)*
  - *Class I UAV imagery feed*
  - *Goggle mounted "look down" display*
  - *Physiological status monitoring*
- *FFW at C4ISR OTM and AAEF/D in 2007*
  - *Precise positioning system*
  - *Low power flexible display demo*
  - *Headgear sensor fusion*
  - *Wireless Personal Area Network and weapons interface*
  - *UGV, UGS integration to FFW platform*
  - *Compact computer (Falcon computer from AFRL)*
  - *Apache digital target hand-off*

Leader Screenshot



Soldier Screenshot

FFW transitions to PEO Soldier in 1QFY08 for Ground Soldier System (next generation Land Warrior)

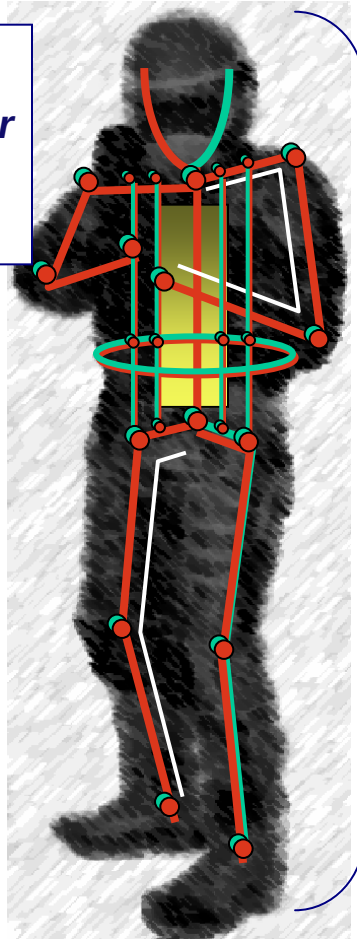
Nanotechnology for Soldiers—2020

Dynamic Battle Suit Enabled by Integrated Systems of Nanotechnologies

On-Demand
Chemical/Biological/Radiological/Nuclear & Blast/Ballistic Global & Directional Sensing & Protection

Physiological Monitoring
Medicines & Healing Agents
Thermal Management

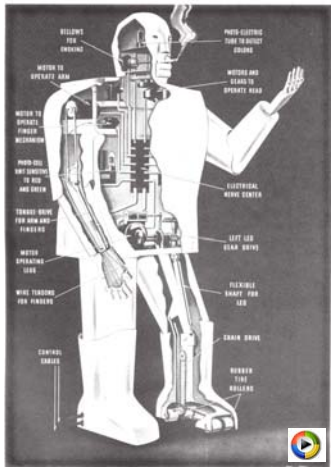
Mechanical Performance Improvement



Networked Sensors, Mechanical Actuators, Chemical Reactors, & Storage Reservoirs…

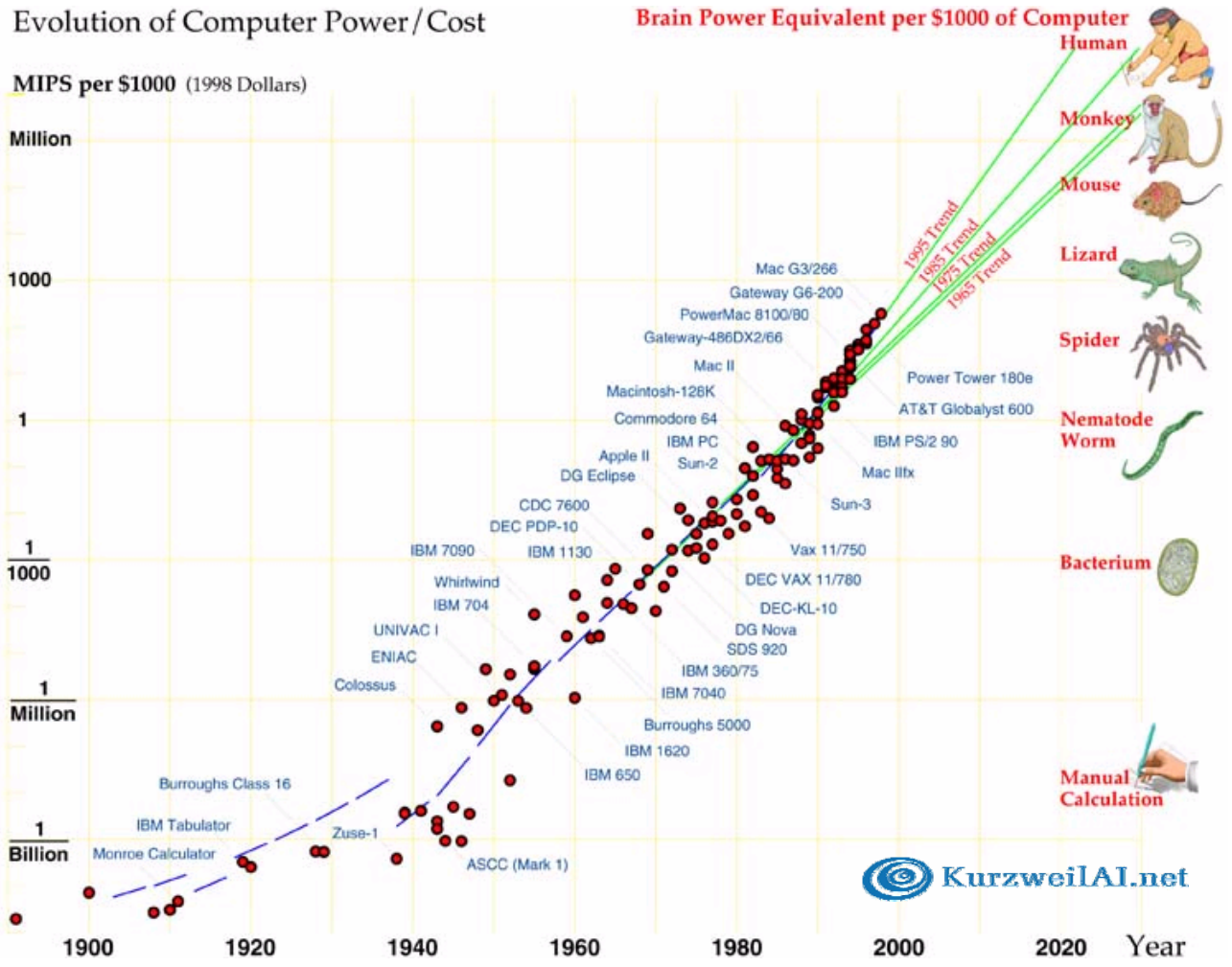
Future Directions
Info & Power Networks
Control of Suit Subsystems

Evolution of Human-like Robotics



Westinghouse Elektro circa, 1939

Honda ASIMO



Assumptions:

- *Continued increase in processing speed*
- *Continued miniaturization of electronic elements*
- *Automated, plug n' play software development*

Progress in Autonomy & Cognition for Operational Capability

Million Instructions/ second

Key Challenges

- High speed mobility
  - Improved perception
  - Reliable data fusion
- Safe operations
  - Detect & classify stationary people & objects
  - Collision avoidance
- Design for tactical behavior flexibility
  - Understand environments
  - Decision processing
  - React appropriately to contact
- Collaboration
  - Conduct collaborative missions with mixed manned/unmanned force
  - Collaborative air-ground operations

1B

10M

100K

1K

Demo IIIa

True follower—follows in tracks of manned leader

On-road convoy operations

Armed Reconnaissance Vehicle—RSTA

Near autonomous team members

2000 2005 2008 2011 2015…

Micro Autonomous Systems—2020

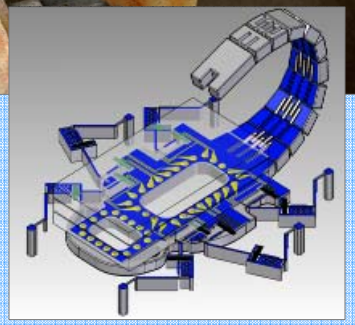
- ***Bio-inspired and bio-mimetic sensing for navigation & control***
- ***"Environmental" data exploitation and understanding is more important in micro-scale systems than sensor performance (e.g., dynamic range, resolution, frame rate)***
- ***Power generation for palm-sized platform***

- ***Collaborative Technology Alliance between Army Research Lab, industry and university partners TBD***

http://www.arl.army.mil/main/main/default.cfm?Action=332&Page=332

Swedish company Proxflyer has come up with an design of a tiny helicopter that weighs only 2.7 grams

Technology demonstrator for small, light self-contained system with control & propulsion

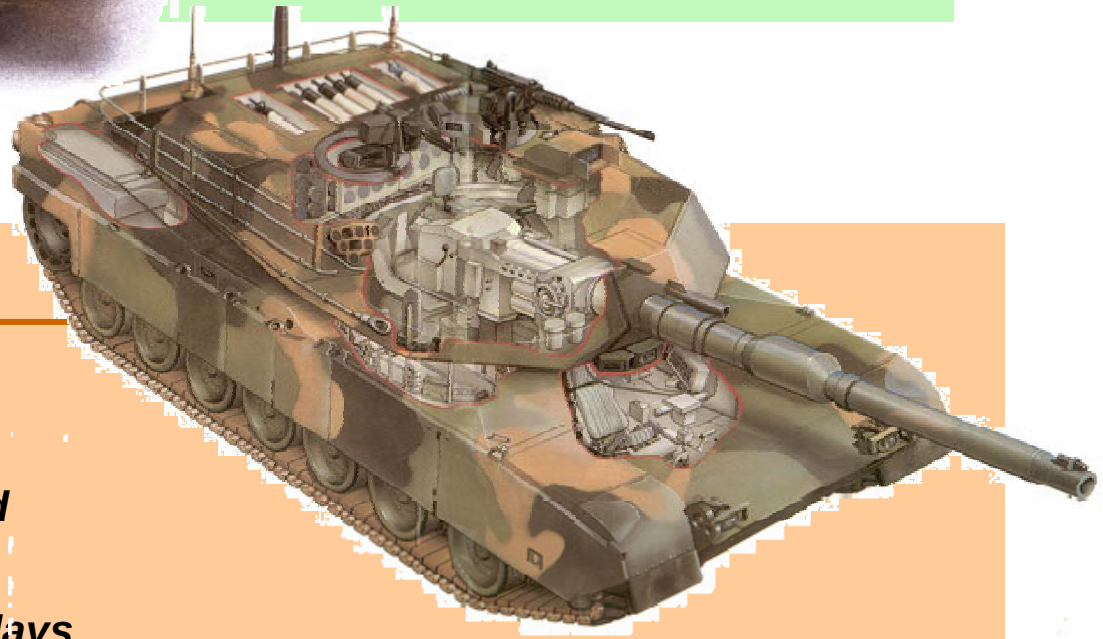


Bio-inspired design for MEMs based navigation and control of autonomous system

Combat Vehicle Crew Station Evolution

M47 Patton

- *FM Radio*
- *Direct View Optics*
- *Engine Gauges*
- *Ballistic Periscopes*



M1A2 Abrams

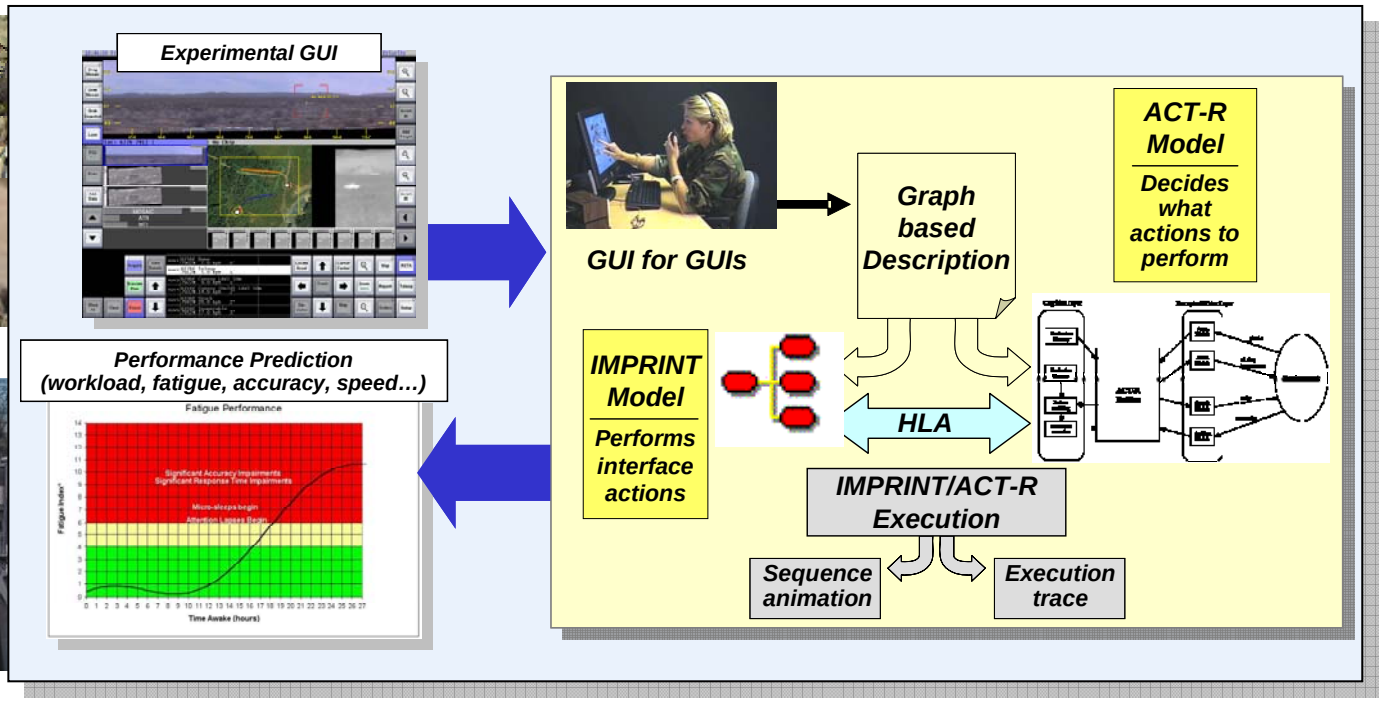
- *Secure data/voice radio*
- *Thermal Viewer*
- *FBCB2 Digital Battle Command*
- *Digital Fire Control*
- *1 Color/3 Monochromatic Displays*

Design Tools for Cognitive Display Interfaces

Mid-size multiple users displays

Large displays, Vehicles & command and control

Small individual displays



Flexible Displays

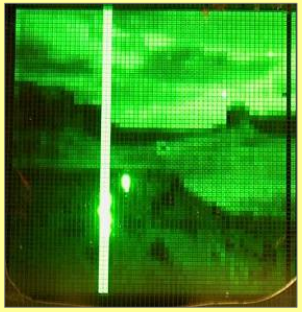
Convergence of Scientific Understanding

- *Miniaturization*
- *Wireless Communications*
- *Processing Speed*
- *Computer Memory*
- *High precision printing technology*

Portable & rugged displays

Current Prototypes

OLED-based Displays

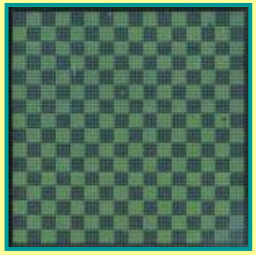


1.1” diag (64x64)

Electrophoretic-based Displays

4” diag (320x240)

Cholesteric LC-based Displays

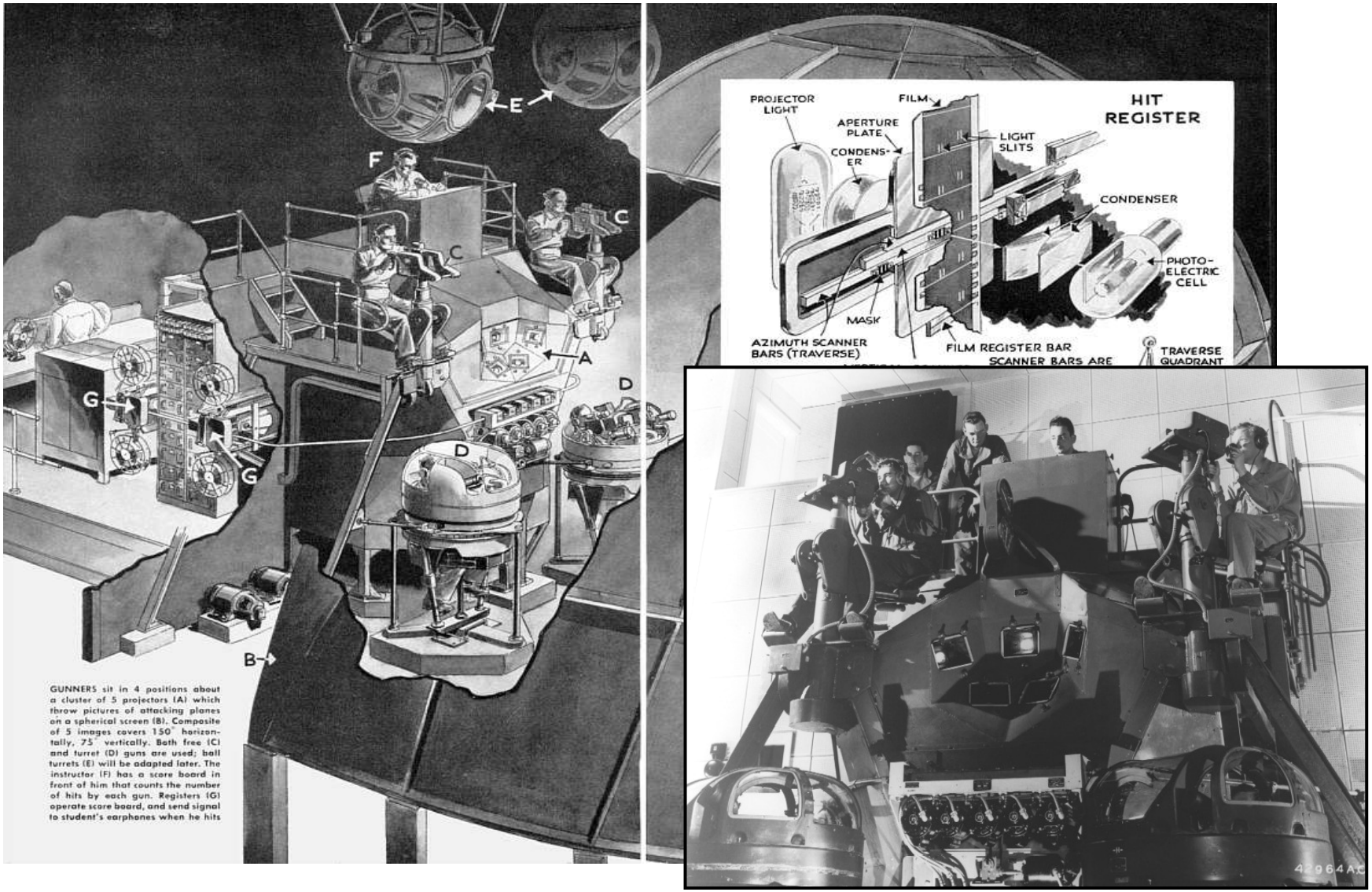


1.1” diag (64x64)

Technologies converging to enable next generation of displays—low power, lightweight, adaptable

Simulation and Training—WWII

Waller Flexible Gunnery Trainer



Joint Fires and Effects Trainer System

Urban Terrain
- *Application of indirect effects in urban battlespace*
- *Cognitive proficiency for better decision-making*

Fires & Effects Command (FEC)
- *Testbed for system and human/machine interface requirements for Networked Fires Command node*

Open Terrain
- *Skill and cognitive trainer*
- *Mounted and dismounted*
- *Range of "individual" to "collective" tasks*

Close Air Support (CAS)
- *Movable flats for mixed reality environments*
- *300-degree perimeter field-of-view*
- *360-degree overhead field-of-view*
- *All rear projection*

Enabling Human to Virtual Human Interaction

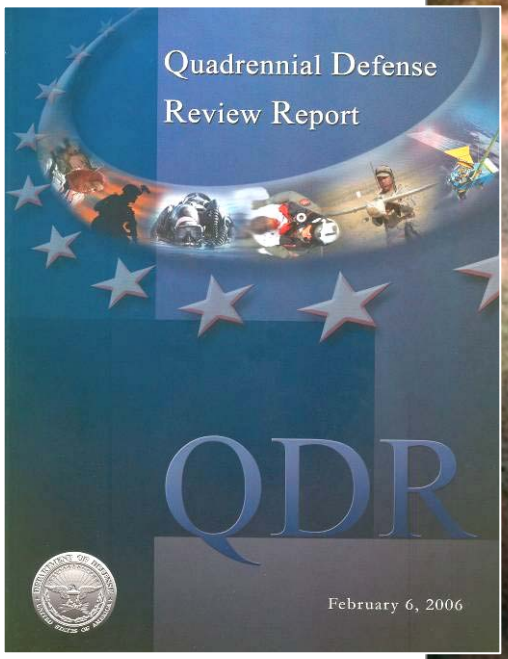
Incorporate dynamics of human thought process, communication and response

- ***Speech recognition***
- ***Natural language processing***
- ***Dialogue management***
- ***Cognition***
- ***Perception***
- ***Emotions***
- ***Animation***
- ***Cultural attributes***

Soldier Avatar

Technology for realistic human representation

The Army…
Transforming while at War



"Technological advances, including dramatic improvements in information management and precision weaponry, have allowed our military to generate considerable more combat capability with the same or, in some cases, fewer numbers of weapons platforms..."